0834-T-01
NS 1.22/10: 996/2

National Science Foundation

Engineering News

Summer 1996

New ERCs Expected to Spark Technological Advances

NSF intends to award over the next 5 years $12 million each to the University of Southern California, the Massachusetts Institute of Technology, the University of Michigan, and the University of Washington to operate four new Engineering Research Centers (ERCs). A total of 117 teams applied for the FY96 awards.

"The new ERCs will develop the next generation of multimedia technology; create better biomaterials for medical implants; develop a modular system for rapid manufacturing; and improve the way firms integrate design, manufacturing, and product development," says Dr. Joseph Bordogna, NSF Assistant Director for Engineering.

"The close collaboration of universities and industry through these ERCs will provide an integrated context for creating new knowledge and educating a new generation of creative, skilled engineers to secure our Nation's leadership position in the world marketplace," he adds.

ERCs may receive NSF funding for up to 11 years, dependent on periodic progress reviews. ERCs emphasize the integration of education programs with research activities that, with input from industry, provide new or improved undergraduate and graduate student curricula, research opportunities, and internships with corporate sponsors and collaborative partners.

The following are the new ERCs:

- Integrated Media Systems Center at the University of Southern California, University Park; Max L. Nikias, Director, and Armand Tanguay, Deputy Director. The center will seek to improve the technologies for combining digital video, digital audio, computer animation, text, and graphics as multimedia displays to facilitate creation, dissemination, and real-time interactive access in mixed media.
- Center for Competitive Product Development at the Massachusetts Institute of Technology; Warren P. Seering, Director, and John Houser, Deputy Director. A collaboration between MIT's Engineering School and the Institute's Sloan School of Management, the center will develop, test, and disseminate improved software tools and models for facilitating the integration of engineering and marketing in design and product development.
- Center for Reconfigurable Machining Systems at the University of Michigan, Ann Arbor; Yoram Koren, Director, and Galip Ulsoy, Deputy Director. The center will develop new manufacturing systems that will be modular, convertible, customizable, integratable, and diagnosable to dramatically reduce the time companies need to launch new manufactured products.
- University of Washington Engineered Biomaterials NSF ERC; Buddy D. Ratner, Director, and Thomas Horbett, Deputy Director. The center will study "biological recognition" mechanisms to develop a new generation of engineered biomaterials for medical implants that will heal in the body easily and normally.

Engineering News Highlights ✓

ENG Seeks Advice on Fundamental Challenges....................2
Joint Effort to Explore Learning and Intelligent Systems..........3
New Earthquake Engineering Research Center Initiative........3
E-Beam System Wins Research Prize..................................4
Fundamental Research in Service to Society.........................4
Grantees' Conference Rises to the Occasion..........................5
Thermal Microscope May Speed Miniaturization Efforts.......5
NSF/SRC Partnership Seeks Safer Semiconductor Manufacturing..6
Staff Update...6
TRP/MET Awards Strengthen U.S. Manufacturing Workforce Skills...7

SPEC Forms State-Federal Group

A newly formed working group established by the Directorate for Engineering's (ENG) Strategic Planning and Evaluation Committee (SPEC) is planning how to foster one of the goals of NSF's Strategic Plan—promoting partnerships.

The State-Federal Partnership Working Group is chaired by Paul Herer, ENG Senior Advisor for Planning and Technology Evaluation. The immediate purpose of the 10-member group—made up of ENG and other NSF staff—is to develop new options and strategies for improving and expanding ENG's State-Federal partnership framework.

For example, the group will examine the results and impact of past and current NSF efforts such as Small Business Innovation Research programs, the Engineering Research Centers, and the State/Industry University Cooperative Research Centers; identify key policy and program planning issues; and recommend new partnership approaches.

Continued on p. 2

NF 97-001125

BEST AVAILABLE COPY

***SPEC Forms State-Federal Group** (Continued from p. 1)*

The group will meet periodically, working under the auspices of SPEC, which will report its findings to the Engineering Management Group.

Among other partnerships, NSF's 1995 Strategic Plan seeks to promote collaborations with State and local governments to respond to a rapidly changing world. The plan emphasizes "a set of principles, goals, and core strategies for science, mathematics, and engineering that are aimed at developing a greater sense of interdependence between the research and education communities and the public."

NSF has participated in a series of efforts by several public and private groups to improve and refine the State-Federal partnership in science and technology policy. These efforts have culminated in the State Federal Technology Partnership (SFTP), consisting of members of academe, industry, and State and local governments.

SPEC's new working group is seen as a microlevel effort to enhance NSF's ability to examine, coordinate, and clarify sets of issues that will find their way to SFTP.

Paul Herer may be contacted at 703-306-1303. Further information about SFTP may be obtained from Kathleen M. Latta, NSF Office of Legislative and Public Affairs, 703-306-1070.

ENG Seeks Advice on Fundamental Challenges

The Engineering Advisory Committee's semiannual meeting to discuss Directorate for Engineering (ENG) policy, program plans, investment strategies, and reports from Committees of Visitors was held at NSF on April 18 and 19, 1996.

NSF *Engineering News* is sponsored by the National Science Foundation's Directorate for Engineering (ENG). Its purpose is to promote current awareness of ENG activities throughout the engineering community by described programs, policies, meetings, research projects, and other activities sponsored by the Directorate. For further information, contact the Editor, Glenn H. Larsen, Directorate for Engineering, National Science Foundation, Arlington, VA 22230, or call 703-306-1306, e-mail glarsen@nsf.gov, TDD# 703-306-0090. Additional information may also be obtained by contacting the Associate Editors in the Divisions, as follows:

Office of the Assistant Director (OAD)
703-306-1304
Ms. Deborah B. Young e-mail dbyoung@nsf.gov

Division of Bioengineering and Environmental Systems (BES)
703-306-1320
Ms. Hope Duckett e-mail hduckett@nsf.gov

Division of Chemical and Transport Systems (CTS)
703-306-1371
Ms. Johnetta E. Lee e-mail jelee@nsf.gov
Ms. Saundra E. Woodard e-mail swoodard@nsf.gov

Division of Design, Manufacture, and Industrial Innovation (DMII)
703-306-1301
Ms. Carol A. Guido e-mail cguido@nsf.gov

Division of Electrical and Communications Systems (ECS)
703-306-1340
Ms. Gwendalyn Owens e-mail gowens@nsf.gov

Division of Engineering Education and Centers (EEC)
703-306-1380
Ms. Esther M. Bolding e-mail ebolding@nsf.gov

Division of Civil and Mechanical Systems (CMS)
703-306-1360
Ms. Stephanie White e-mail smwhite@nsf.gov

To set a context for the meeting, ENG staff reviewed the current state of ENG's strategic thinking, budget planning and emphasis areas, and emerging trends in engineering research and education.

Themes of growing importance to many fields that are shaping the focus of ENG programs include complexity, environmental consciousness, embedded intelligence in engineering systems, new kinds of sensors and engineering systems that use them in new ways, computing power as an enabler for research, engineering of material properties on smaller and smaller scales, uncertainty as an inherent part of a system, and a closer link to social science perspectives. In some ENG programs, a shift has become apparent in the choice of research direction described in unsolicited proposals, reflecting a recognition that research results are now more likely to be of interest for developing commercial products and processes rather than for military applications.

A lively discussion took place with Dr. Neal Lane, Director of NSF, on a range of issues including the urgent need for vigorous effort to improve engineering, science, mathematics, and technical education at all levels and for all groups who are part of our society; NSF's Strategic Plan (http://www.nsf.gov:80/od/lpa/strtplan.pdf); the strain on discretionary spending in the federal budget and therefore on NSF; and the Government Performance and Results Act. Dr. Lane reiterated that integrating research and education is an essential focus at NSF, especially to provide all undergraduates with a rich experience in exploration and discovery.

Dr. Elbert Marsh, ENG Deputy Assistant Director, and Dr. Patti Ota, the Advisory Committee's liaison with the Committee on Equal Opportunity in Science and Engineering (CEOSE, a Congressionally mandated advisory committee to NSF), led a discussion of equal opportunity and managing diversity. To help NSF shape new guidance to the academic community, Committee members shared information about how their home states and institutions are responding to the new "strict scrutiny" legal environment. The broader concept of affirmative action was reaffirmed as a way of thinking that permeates all NSF interactions with its constituencies.

Dr. Brij Moudgil, Director of the NSF-supported Engineering Research Center for Particle Science and Technology at the University of Florida (http://www.erc.ufl.edu), spoke to the Committee about engineering research challenges in particulate systems. Particulate systems encompass the production, characterization, modification, handling and utilization of organic and inorganic particles, in both wet and dry conditions. Dr. Moudgil described ongoing work at the ERC, which aims to understand, monitor and modify particle behavior for efficient utilization of particles in existing and emerging industries, to develop cost-effective processing and handling of particulate systems, and to educate students and other professionals to be more effective in engineering practice involving particulate systems.

Dr. Bruce Kramer, ENG Division Director for Design, Manufacture, and Industrial Innovation, outlined current manufacturing engineering research issues and described the industry-led Next Generation Manufacturing (NGM) Project, an 18-month effort initiated in 1995 to define and prioritize requirements for future manufacturing systems, the role of infrastructural technologies, and their relationship to business practices and human systems. NGM developed from manufacturing infrastructure planning within the President's National Science and Technology Council (NSTC) and draws upon the perspectives and resources of U.S. manufacturing companies and industry associations, university researchers, and Federal, State, and Local government agencies, labs, and workforce organizations.

Dr. David Schindel of NSF's Office of Science and Technology Infrastructure described the new NSF Recognition Awards for the Integration of Research and Education (NSF Publication No. 96-87). NSF intends to make awards that recognize up to 10 research-intensive universities that have shown leadership, innovation, and achievement in their efforts to integrate research and education (specifically college freshmen through Ph.D.) throughout their organizations.

Ms. Kathleen Latta, NSF's liaison to State organizations and State initiatives, brought the Advisory Committee up to date on the history of NSF partnerships with States for the support of research and education. Usually these activities result from joint planning through representative organizations such as the National Governors Association and the National Conference of State Legislatures. NSF is working to enrich these partnerships, particularly to link NSF-supported small business innovation research (SBIR) projects and university research and education to efforts aimed at building local and regional capacity for economic growth.

Further information about the Advisory Committee meeting may be obtained from Dr. Christina Gabriel at cgabriel@nsf.gov or 703-306-1302.

Members of the NSF Engineering Advisory Committee:

Dr. Alice M. Agogino (Chair), University of California, Berkeley

Dr. David Wormley (Vice Chair), Pennsylvania State University

Dr. Jane C. Ammons, Georgia Institute of Technology

Dr. Jose B. Cruz, Jr., Ohio State University

Dr. Bonnie J. Dunbar, National Aeronautics and Space Administration

Dr. Elsa Garmire, Dartmouth College

Dr. Ignacio Grossman, Carnegie Mellon University

Dr. Henry Kressel, E.M. Warburg, Pincus and Company

Dr. Gary S. May, Georgia Institute of Technology

Dr. Joel Moses, Massachusetts Institute of Technology

Dr. Banu Onaral, Drexel University

Dr. Patti T. Ota, Lehigh University

Dr. Arati Prabhakar, National Institute of Standards and Technology

Dr. Melvin R. Ramey, University of California, Davis

Dr. Pieter J. von Herrmann, CHARON Industries, Inc.

Joint Effort to Explore Learning and Intelligent Systems

The Directorate for Engineering (ENG) has joined other NSF directorates in a new thrust on Learning and Intelligent Systems (LIS), an area that engineers, scientists, and educators believe will offer exciting and promising new research and education opportunities.

A precursor to LIS is the Collaborative Research in Learning Technologies (CRLT) initiative, whose objective is to stimulate research on the integration of technology with learning at all levels of education—from elementary schools to universities, and from learning in the classroom to self-directed lifelong learning.

This joint program, the first of several comprising the LIS thrust, is sponsored and managed by ENG and the Directorates for Computer and Information Sciences and Engineering (CISE), Education and Human Resources (EHR), and Mathematical and Physical Sciences (MPS). Projects are expected to involve a significant research component in the information, computer, communications and computation science, and engineering aspects of learning technologies.

The core research and education opportunity focuses on the development of new mathematical designs that bridge the gap between engineering-based approaches (especially the synthesis of artificial neural networks) and machine-learning approaches popular in computer science. These designs will serve two purposes: as blueprints for artificial learning systems, tested for their ability to learn to solve very difficult engineering challenges, and as models for the learning capabilities of the brain that utilize the findings of cutting-edge experimental neuroscience.

Engineering-neuroscience collaboration is considered crucial for advances in LIS. Part of this collaboration involves the use of engineering challenges to inform and influence new general purpose learning designs.

The scope of the CRLT program is threefold:

- To fund research projects that establish collaborations among researchers with all of the relevant disciplinary perspectives;
- To fund a number of smaller exploratory research grants that foster productive collaboration and explore possible new areas of research opportunity; and
- To establish one or more real or virtual CRLT centers to undertake larger collaborative projects, act as a technology transfer mechanism by training new researchers and supporting prototype or model projects, and act as evaluation centers for research.

Examples of research topics will include computational tools in learning—visualization, simulations, and other computationally intensive methodologies; collaborative learning across physical and virtual communities; facilitation of the networked and technology-rich classroom; tools for building educational technologies and technology-enabled applications; understanding learner-system interactions; collaborative human-machine learning; and application of digital libraries to learning.

The deadline for CRLT grant proposals was July 15, 1996. For further information, contact Drs. John C. Cherniavsky, CISE (e-mail: jchernia@nsf.gov); Nora H. Sabelli, EHR (e-mail: nsabelli @nsf.gov); John W. Prados, ENG (e-mail: jprados@nsf.gov), or Alvin Thaler, MPS (e-mail: athaler@nsf.gov).

New Earthquake Engineering Research Center Initiative

A newly announced initiative by NSF's Directorate for Engineering (ENG) to fund Earthquake Engineering Research Centers is expected to extend understanding of the impact of seismic events on the built environment and social institutions.

The centers will be funded through ENG's Earthquake Hazard Mitigation (EHM) Program, and will complement the earthquake research and educational activities carried out in individual and small group projects supported through EHM, emphasizing multidisciplinary and coordinated team research.

Continued on p. 4

Earthquake Engineering Research Center *(Continued from p. 3)*

EHM has long been concerned with the discovery, integration, and use of knowledge in earthquake engineering and related disciplines. Previous awards funded the National Center for Earthquake Engineering Research at the State University of New York at Buffalo.

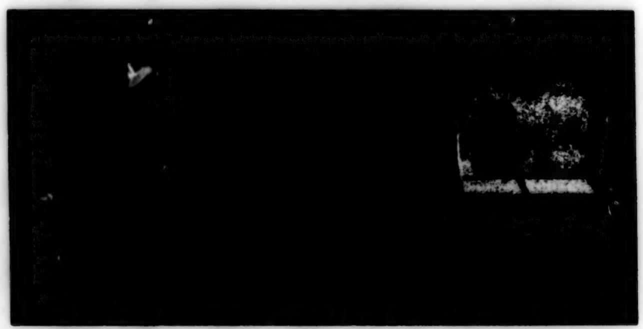
In addition to facilitating a cross-disciplinary team approach to engineering and related research, the new centers are expected to include the following features:

- A strategic vision and plan that allows for the pursuit of knowledge in a holistic and integrated fashion, with emphasis on the systems aspects of earthquake hazard mitigation;
- Educational and training opportunities for undergraduate and graduate students, including opportunities for research experience;
- Outreach to industry, Government, precollege schools, and potential user groups;
- A center director who provides leadership, a team of committed faculty, and a management team that provides support and guidance to the director; and
- An external oversight committee made up of representatives from industry, Government, and academe that provides advice on center goals, planning, research thrusts, and accomplishments relative to the Nation's needs for earthquake hazard mitigation.

Proposals are due to NSF before the close of business on October 15, 1996. For program inquiries, contact one of the following staff members at the Earthquake Hazard Mitigation Program, Division of Civil and Mechanical Systems, Room 545, National Science Foundation, 4201 Wilson Boulevard, Arlington, VA 22230 (telephone 703-306-1362): Dr. William A. Anderson (e-mail wanderso@nsf.gov), Dr. Clifford J. Astill (e-mail castill@nsf.gov), or Dr. S.C. Liu (e-mail sliu@nsf.gov).

E-Beam System Wins Research Prize

PRC Environmental Management, Inc., using electron-beam technology that emerged from research supported by NSF's Environmental Engineering program, won the 1996 Grand Prize for Research awarded by the American Academy of Environmental Engineers. The prize is awarded annually in a competition to identify advances and innovations in environmental engineering practice.



Field trials were conducted using a 30-gallon-per-minute trailer-mounted unit.

E-beam technology treats contaminated water with high-energy electrons.

Electron beam (E-beam) research funded by awards to the University of Miami and Florida International University's Drinking Water Research Center led to formation by the three coinvestigators of High Voltage Environmental Applications, Inc., the company that produced the mobile E-beam unit used by PRC Environmental Management, Inc., in its prize-winning research. The project involved use of the E-beam to decontaminate groundwater at the Department of Energy's Savannah River site in Aiken, SC, under a contract with the Environmental Protection Agency to evaluate this innovative process for destroying groundwater contaminants.

The Academy's award winner was selected by an independent panel of nationally recognized experts for its "11" holistic environmental perspective, innovation, performance and customer satisfaction, and contribution to an improved quality of life and economic efficiency."

NSF Directorate for Engineering's (ENG) role in support of E-beam research was highlighted by Dr. Edward H. Bryan, ENG's Environmental Engineering Program Director, in San Francisco at the NSF/Electric Power Research Institute's Second International Symposium on Environmental Applications of Advanced Oxidation Technologies. He traced the research path that led to this award-winning application of E-beam radiation in environmental engineering practice and noted that NSF, through its Small Business Innovation Research (SBIR) program, has recently supported research on the feasibility of a windowless exit portal for electron accelerators and on the use of the E-beam to disinfect hospital wastes as a step toward reducing the cost of their management.

Further information may be obtained by contacting Dr. Bryan at 703-306-1318, or Dr. K. Topudurti, PRC Environmental Management, Inc., 200 East Randolph Drive, Chicago, IL 60601, 312-856-8742.

Fundamental Research in Service to Society

Decades of extraordinary accomplishments in fundamental research by NSF and other Federal and nongovernment research groups have led to practical advances, illustrating the value of such research. In a recent statement, the National Science Board (the independent policymaking body of NSF) said, "Basic research is not intended—nor should it be expected—to advance short-term goals. Rather, it is an investment that, like education, takes time to mature but has tremendous practical payoffs in the long run."

The history of fundamental research is replete with examples of discoveries that resulted from the intuitive brilliance of an investigator who extrapolated a finding from one field to another area. Take, for example, the NSF-funded work that developed the equations describing the behavior of fluid as it leaves an ink jet printer.

The research had nothing to do with printing at all. In 1973, NSF awarded a grant to study the backflow behavior of blood in artificial heart valves. This research led to the introduction of the St. Jude heart valve, which remains the most widely used in the world.

An engineer who was working on this NSF-funded research as a student went on to work in industry, where it occurred to him that the heart valve research could be applied to ink jet printing. Ink jet printers arrived on the market in the late 1980s. It took more than 10 years to move from basic research to this unforeseen commercial use.

There are many other examples of an investigator being moved by a scientific hunch, pursuing the inquiry, and producing useful and important knowledge. The following are examples from the long list of NSF basic research success stories:

- Doppler radar, used at airports and mentioned often in television weather reports, is the direct result of research at the National Center for Atmospheric Research.
- Web browsers such as Mosaic and Netscape emerged from research at the National Center for Supercomputing Applications.
- El Niño predictions can be made up to a year in advance, thanks to a new understanding of ocean surface temperatures. These extra months of preparation save billions of dollars and countless lives.
- Compact disc players rely on data compression algorithms funded in part by NSF years ago as a curiosity and first used for satellite transmission.
- The General Electric Company's digital feeder monitor helps in the detection of downed live conductors on electric power distribution networks. In the past, downed conductors were difficult to detect, causing accidents and loss of life.
- Passive energy dissipation technology can be applied to the seismic upgrading and strengthening of existing structures in earthquake-prone areas.

NSF has also invested in incremental research efforts that have spawned great savings to U.S. industry and stimulated growth in manufacturing. For example, a student of an NSF grantee developed a fundamentally new approach to mathematical programming and subsequently went to industry, where he developed a commercial version of his code. His results served as a catalyst for other researchers, making existing procedures much more efficient and enabling mathematical optimization to make a major advance. Because of that student's basic research, industrial problems that could not be approached 10 years ago are now solvable, resulting in a gain to the U.S. economy equivalent to hundreds of millions of dollars.

Many scientists and engineers believe that, despite its preoccupation with immediate, tangible benefits, the American public accepts the principle that technological advances are the products of a continuing flow of new knowledge that is attainable only through free fundamental inquiry.

Grantees' Conference Rises to the Occasion

The Division of Design, Manufacture, and Industrial Innovation's annual Grantees' Conference features an exciting agenda, with presentations from industry and Government representatives. This year, despite the furlough that prevented Federal employees from attending and forced the cancellation of several agenda items, the conference hosts put together another successful meeting.

Held at the Albuquerque Convention Center January 3–5 and hosted by the University of New Mexico (UNM), Sandia National Laboratories, and the National Center for Manufacturing Sciences, the conference attracted more than 450 people. The attendees included NSF grantees whose research is in engineering design, manufacture, and supporting technologies, and a contingent from the National Council for Manufacturing Sciences (NCMS), as well as other industry representatives.

Drs. Mohsen Shahinpoor and Ron Lumia from UNM and William Alzheimer and Patti Sanchez from Sandia developed a new agenda, calling on several distinguished attendees to fill in at the last minute for the missing Federal representatives. According to the participants, the presentations, topped with a talk on the making of the Boeing 777, were a "rousing success." Local television provided media coverage of the events. In addition to the talks and poster presentations, the attendees toured Sandia Laboratories and UNM, viewing facilities for advanced design and manufacture with a focus on rapid prototyping and virtual manufacturing.

Every year, each grantee at the conference gives a poster presentation, and the resulting 400-plus posters provide an outstanding review of the state of the art in engineering design and manufacture. The conference gives grantees the opportunity to display their research and to see other complementary research NSF is funding.

The goals of the conference are to encourage links among researchers, to ensure that all funded researchers are in touch with the latest developments in relevant fields, to give industry an overview of NSF-funded research, and to promote quality in engineering research and education.

Following this year's conference, proceedings were posted on the Internet at http://shah4.unm.edu. This address is also the NSF 1996 Design and Manufacturing Grantees' home page. Users can search the proceedings for key words, authors, and topics. High-end graphics, videos, and animation are included.

Next year's conference will be held at the Westin Hotel, Seattle, WA, January 7–10, 1997, and hosted by the University of Washington (Dr. Tony Woo). Conference information will be available on the World Wide Web at http://www.engr.washington.edu/~uw.epp/nsf.html.

Thermal Microscope May Speed Miniaturization Efforts

NSF-supported researchers using a newly invented scanning thermal microscope can, for the first time, measure temperatures with nanometer scale spatial resolution. This achievement by Dr. Arunava Majumdar and his group at the University of California, Santa Barbara, with support from the Directorate for Engineering's Division of Chemical and Transport Systems, will ultimately enable further miniaturization of electronic components and the associated benefits of computer performance.

The dramatic improvements in the speed and capacity of computer hardware that have occurred over the past few decades are the result of the extreme miniaturization of electronic devices. However, these advances have not come without a price; the ever-increasing density of devices has led to high heat generation rates and the possibility of excessive temperatures.

Continued on p. 6

Thermal Microscope *(Continued from p. 5)*

The scanning thermal microscope consists of a nano-thermocouple (a hundredth nanometer size temperature sensor) junction supported on a cantilever probe. Several designs were fabricated, from simple wire probes to complex nanofabricated thin film thermocouples. The microscope was then used to explore the hot zone at the gate of a transistor and the grain boundaries of polycrystalline materials.

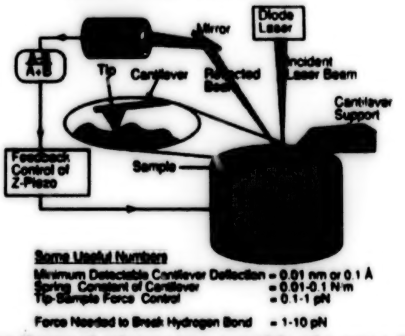
The outstanding achievement of Majumdar's group is the resolution of temperatures at a scale of 80 angstroms. (Large long-chain molecules such as DNA have a width on the order of 10 angstroms.) With 80-angstrom resolution, defects within transistors and hot spots in vertical-cavity, surface-emitting quantum well lasers can be clearly seen.

This information will enable engineers to further miniaturize computer circuits and increase computer speed and power. Motorola has been using the scanning thermal microscope for imaging devices and interconnects, and two manufacturers of atomic force microscopes, Digital Instruments and Topometrix, have started to manufacture thermal probes for their microscopes. The University of California has applied for a patent on probe nanofabrication.

Miniaturization has been a major driver in the increasing capabilities of computers. In addition, as the technique is developed further, it may be possible to scan the thermal field of a single molecule, leading to fundamental advances in the understanding of optical absorption and scattering by molecules, chemical reactions, and phase transformation.

Further information may be obtained by contacting Dr. Majumdar at 805-893-4490.

Atomic Force Microscope


Diode Laser
Mirror
A-B / A+B
Tip
Cantilever
Reflected Beam
Incident Laser Beam
Cantilever Support
Feedback Control of Z-Piezo
Sample
Some Useful Numbers
Minimum Detectable Cantilever Deflection = 0.01 nm or 0.1 Å
Spring Constant of Cantilever = 0.01-0.1 N/m
Tip-Sample Force Control = 0.1-1 pN
Force Needed to Break Hydrogen Bond = 1-10 pN

The scanning thermal microscope consists of a nano-thermocouple junction supported on a cantilever probe.

NSF/SRC Partnership Seeks Safer Semiconductor Manufacturing

A concerted effort to study the environmental, health, and safety aspects of the semiconductor manufacturing process is being initiated through a partnership between NSF and the Semiconductor Research Corporation (SRC).

The NSF/SRC Engineering Research Center (ERC) for Environmentally Benign Semiconductor Manufacturing is located at the University of Arizona and led by Professor Farhang Shadman, a chemical engineer. Through the ERC, engineers and scientists from the University of Arizona, Massachusetts Institute of Technology, Stanford University, and the University of California, Berkeley, will address the semiconductor industry's long-term need for a more environmentally sound manufacturing process.

NSF and SRC will each commit $1 million a year for 5 years. SEMATECH, the semiconductor industry's manufacturing-technology development consortium, will contribute $750,000 in startup funds.

The semiconductor industry makes electronic components for products that fuel the Information Age, such as cellular phones, personal computers, VCRs, and televisions. Complex electronics also play an integral role in a variety of other products, including automobiles, medical instruments, and children's toys.

The global semiconductor industry supports an annual worldwide market of $150 billion and provides essential resources for much larger markets. The U.S. share of the global market is approximately 40 percent and growing each year. The market is expected to grow to $183 billion in 1996 and exceed $238 billion in 1998. The U.S. semiconductor industry employs 272,000 workers and provides the enabling technology for an electronics industry that employs 2.5 million U.S. workers.

An essential issue for the semiconductor industry is the development and use of environmentally sound manufacturing processes. One focus is the large amount of highly purified water required to rinse and clean each silicon wafer from which integrated circuit chips are made. The industry is interested in reducing water use through innovative technology development. It also needs to minimize the amount of energy required to manufacture microchips.

Although the semiconductor industry's share of total fluorocarbon use is small, the industry is very concerned about the impact on the ozone layer. Most manufacturers have stopped using ethylene-based glycol ethers—fluorocarbons used as cleaning solvents. To replace them, the industry is looking for safe solvent alternatives.

The ERC will work in partnership with semiconductor firms in order to contribute to strategic planning of the research program. These firms will interact with faculty and student teams in research, and provide opportunities for student interns to learn the manufacturing process firsthand by performing industrially relevant research while they are still in school. ERC graduates will be part of a new generation of engineers capable of integrating environmentally conscious concepts up front in the design of manufacturing processes.

NSF established the Engineering Research Centers program in 1985 to build partnerships between universities and industry in economically important technology areas. With sustained, committed industrial involvement, the centers shape a long-term, coherent vision for fundamental advances in their technology area and support an integrated program of engineering research and education. ERC graduates are professionally oriented engineers who are able to create, integrate, and move new knowledge effectively into productive implementation in industry.

Further information may be obtained by contacting Professor Shadman at 520-621-6052.

Staff Update

Dr. Gary Poehlein, from the Georgia Institute of Technology, will be on a 2-year Intergovernmental Personnel Agreement (IPA) appointment as Division Director, Division of Chemical and Transport Systems (CTS), beginning September 1, 1996.

Dr. Raul Miranda, University of Louisville, will begin a 2-year IPA appointment, September 1, 1996, as a Program Director for Chemical Reaction Processes (Kinetics) in CTS.

Dr. Timothy Tong, Arizona State University, will be on a 2-year IPA appointment as Program Director in Thermal Systems, CTS, beginning September 1, 1996.

Dr. Vijay T. John, Tulane University, will begin a 2-year IPA appointment September 1, 1996, as Program Director for the Interfacial, Transport, and Separation Process Program, CTS.

Dr. Georgia-Ann Klutke, Texas A&M, began a 2-year IPA appointment in May of 1996 as Program Director, Operations Research and Production Systems, division of Design Manufacture and Industrial Innovation (DMII).

Dr. Joseph Hennessey, Armstrong World Industries, began his appointment as a Visiting Engineer in May, 1996, as Program Director for Small Business Innovation Research (SBIR) program.

Dr. Ronald L. Sack, University of Oklahoma, will begin a 2-year IPA appointment on September 1, 1996, as Division Director of the Civil and Mechanical Systems Division.

Ms. Nicola Bell became a Program Assistant in DMII's SBIR Program in October 1995.

TRP/MET Awards Strengthen U.S. Manufacturing Workforce Skills

The Manufacturing Education and Training (MET) awards funded under the Federal Technology Reinvestment Project (TRP) are playing a major role in strengthening U.S. manufacturing workforce skills. The awards, representing new partnerships formed among industry, educational institutions, and Government to develop manufacturing education and training programs, have two purposes:

- To help in the transition of U.S. manufacturing to an integrated, dual-use (commercial and military) industrial base that can provide both advanced, affordable military systems and competitive commercial products; and
- To educate a world-class technical workforce for the 21st century that can function effectively in a dual-use manufacturing regime.

TRP is a collaborative, multiagency effort involving the National Science Foundation with eight other Federal agencies and military services. MET is one of the three main thrust areas of TRP; the others are Technology Development and Technology Deployment.

Manufacturing covers a broad range of technologies, encompassing the full continuum of materials, products, and processes—from chemical and biotechnology processing to electronic component and system fabrication, durable goods production, fabrication of structures, and other manufacturing sectors.

To implement MET projects and ensure that educational curricula and training activities are relevant, the emphasis is on dual-use engineering skills for active and displaced defense engineers and others; improved manufacturing engineering curricula at schools, with input for these innovations provided by industry; and the use of experienced manufacturing experts and engineers in the classroom.

As a result of the fiscal year 1993 MET competition, 354 proposals were received and 57 awards were made, totaling approximately $60 million. All awards required minimum industrial cost-sharing of 50 percent. The following are noteworthy examples of MET partnerships among industry, educational institutions, and Government:

- The Partnership for Retraining and Innovations in Delivering Education (PRIDE) is a collaborative network to deliver advising and education for active and displaced defense workers at the Philadelphia Naval Base, which closed in September 1995. PRIDE leads the way to a new paradigm: accessible, economical, and agile manufacturing education and training. The partnership includes Drexel University and a number of colleges and area industries.
- The Southern California Coalition for Education in Manufacturing Engineering (SCCEME, pronounced "scheme") is a coalition of six participating universities in southern California, along with national, State, and local government agencies; industry groups; and companies. Its mission is to develop a comprehensive system of interuniversity programs of undergraduate manufacturing engineering education and training programs for workers in manufacturing.
- The Intermountain Manufacturing Education and Training Partnership is a highly integrated partnership among a number of colleges, universities, and technology centers in the Utah, Idaho, and Wyoming intermountain region. Using distance learning, interactive computer-based modules, and other delivery systems, the partners are creating a custom training outreach program for military sites and 3,000 targeted companies in the region.

These and other innovative projects will contribute to building the skilled technical workforce needed as the Nation moves to a dual-use manufacturing base. No new awards, however, are planned at the present time.

For further information, please contact the World Wide Web site at http://www.eng.nsf.gov/eec/met/trp.html.

Calendar of Events

(Listed events involve ENG sponsorship or participation.)

NSF 1996 Exhibit Schedule

Nov. 6–9	BES—Environmental Technology Expo, Atlanta, GA
Nov. 10–14	CMS—American Society of Civil Engineers (ASCE), Washington, DC
Nov. 11–14	CTS—American Institute of Chemical Engineers (AIChE), Chicago, IL (hospitality suite)
Nov. 19–21	DMII—International Mechanical Engineering Congress & Exposition, Atlanta, GA
Jan. 7–10, 1997	DMII—NSF Design and Manufacturing Grantees' Conference, Seattle, WA

NATIONAL SCIENCE FOUNDATION
ARLINGTON, VA 22230

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE $300

BULK RATE
POSTAGE & FEES PAID
National Science Foundation
Permit No. G-69

A MALHORTA 00130991 MIS500
DEPOSITORY ADMINISTRATION BRANCH
US GOVERNMENT PRINTING OFFICE
STOP SLLC/RM C-618
WASHINGTON DC 20401-0001

END

01-29-97